

WHAT IS CLAIMED IS:

1. A method of determining at least one surface property of at least one solid or mixture of solids comprising desorbing adsorbed adsorbate from the solid(s) while measuring the radiation emitted, absorbed, or altered by the respective solid(s) using a detector; and determining at least one surface property of at least one solid or mixture of solids using the radiation measurements.
2. The method of Claim 1 wherein the desorbing is accomplished using a technique selected from the group consisting of temperature ramping and pressure ramping.
3. The method of Claim 1 wherein at least one surface property of a multiplicity of solids or mixtures of solids is determined.
4. The method of Claim 1 wherein at least one surface property of a multiplicity of solids or mixtures of solids is determined concurrently.
5. The method of Claim 1 wherein the radiation and detector are those used in a technique selected from the group consisting of infrared spectroscopy, ultraviolet spectroscopy, visible spectroscopy, fluorescence, infrared thermography, nuclear magnetic resonance, electron paramagnetic resonance, x-ray adsorption, x-ray photoelectron spectroscopy, Raman spectroscopy, and combinations thereof.
6. The method of Claim 3 further comprising identifying the solid or mixture of solids having the value, relative or absolute, of the surface property that is closest to a predetermined value.
7. The method of Claim 1 wherein the surface property is selected from the group consisting of relative adsorptivity, acid site distribution, acid site energy or acid site strength, acid site strength distribution, base site strength, number of base sites, base site distribution, porosity, pore size, pore density, pore volume, pore shape, surface area, metal dispersion, exposed metal surface area, mobility of metals on the

surface of a solid, chemisorb properties, physisorb properties, adsorption selectivity, desorption, ion-exchange capacity, and combinations thereof.

8. The method of Claim 1 further comprising contacting the solid(s) or mixture(s) of solids with a stream of inert fluid prior to contacting the solid(s) or mixture(s) of solids with the adsorbate.

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9. The method of Claim 8 further comprising substantially simultaneously measuring radiation emitted, absorbed, or altered by the respective solid(s) or mixture(s) of solids using the detector during the contacting of the solid(s) or mixture(s) of solids with the stream of inert fluid to generate a baseline.

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10. The method of Claim 1 further comprising correcting the measurements collected during the contacting with the adsorbate by subtracting a baseline.

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11. The method of Claim 8 further comprising ramping the temperature of the solid(s) or mixture(s) of solids to a predetermined maximum temperature during the contacting the solid(s) or mixture(s) of solids with a stream of inert fluid.

12. The method of Claim 11 further comprising substantially simultaneously measuring radiation emitted, absorbed, or altered by the solid or mixture of solids using the detector during the contacting of the solid or mixture of solids with the stream of inert fluid while ramping the temperature in order to generate a baseline.

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13. The method of Claim 12 further comprising correcting the measurements collected during the contacting with the adsorbate by subtracting the baseline of Claim 12.

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14. The method of Claim 1 wherein the solid(s) or mixture(s) of solids are selected from the group consisting of catalysts, adsorbents, polymers, ceramics, metals, and various types of carbons.

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15. The method of Claim 1 wherein the solid(s) or mixture(s) of solids are selected from the group consisting of molecular sieves, including zeolites, aluminas, silicas, amorphous silica aluminas, zirconias, mixed metal oxides, clays, ion exchange resins, and polymers including functional polymers.

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16. The method of Claim 1 wherein at least one support comprises a plurality of wells.

17. The method of Claim 1 wherein the adsorbate is selected from the group consisting of water, pyridine, ammonia, hydrogen, nitrogen, air, helium, argon, fluorine, neon, alkanes, alkynes, alkenes, alcohols, aromatics, thiols, esters, ketones, aldehydes, esters, amides, nitriles, nitroalkanes, amines, alkylamines, quinoline, carbon monoxide, carbon dioxide, and carboxylic acids.

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18. The method of Claim 1 further comprising contacting the solid(s) or mixture(s) of solids with an adsorbate for a period of time prior to the desorbing.

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19. A method of quantifying the amount of adsorbate adsorbed on a solid comprising:

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a) contacting the solid with an adsorbate for a period of time;

b) contacting the solid with an inert fluid while ramping the temperature of the solid resulting in a specified ramp rate with a fixed heat input profile with respect to a blank run;

c) measuring the change in temperature of the solid during the contact with the inert fluid;

d) determining a mathematical function,  $f(t)$ , describing the deviation of the measured changes in temperature over time from the specified temperature ramp rate;

e) determining a value of the desorption order, "m", that yields a linear relationship of  $\ln[(-d N_A /dt)/ N_A^m]$  vs  $1/T$  where "N<sub>A</sub>" is the total moles of adsorbate adsorbed on the solid, "t" is time, "t<sub>p</sub>" is

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the time at which the extremum is observed, and "T" is temperature;

f) determining the activation energy for desorption using :

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$$-10^{13} \cdot \exp\left(\frac{-E_d}{RT_p}\right) + \frac{E_d}{RT_p^2} [\beta - f'(t)] \Big/ t_p \quad (8)$$

when "m" is determined above to be 1, or using

$$-\nu \cdot m \cdot N_A^{(m-1)} \cdot \exp\left(\frac{-E_d}{RT_p}\right) + \frac{E_d}{RT_p^2} [\beta - f'(t)] \Big/ t_p = 0 \quad (7)$$

when "m" is determined above to be other than 1; and

g) determining the quantity of adsorbate adsorbed on the solid using:

$$N_A = \int_{t_1}^{t_2} f(t) \cdot \frac{C_{ps}}{\Delta H} dt \quad (1')$$

where "C<sub>ps</sub>" is the specific heat of the solid and ΔH is the heat of adsorption of adsorbate "A" which is substantially equal to the activation energy for desorption determined above.

15 20. The method of Claim 19 wherein steps (a) through (g) are conducted on a plurality of solids.

21. The method of Claim 19 wherein the expression describing the deviation of the measured changes in temperature over time from the specified temperature ramp rate,  $f(t)$  is a polynomial described as:

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$$f(t) = \sum_{i=0}^n a_i \cdot t^i$$

22. A method of determining at least one surface property of at least one solid or mixture of solids comprising:

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- a) contacting the solid(s) or mixture(s) of solids with an adsorbate for a period of time;
- b) contacting the solid(s) or mixture(s) of solids with an inert fluid while measuring the change in temperature of the respective solid(s) or mixture(s) of solids using a detector and while concurrently ramping the temperature at a controlled ramp rate using temperature controllers to a temperature sufficient to desorb adsorbed fluid;

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- c) controlling the heating of the samples and maintaining the controlled temperature ramp rate using the measured change in temperature of the solid(s) or mixture(s) of solids;
- d) measuring the power requirements of the temperature controllers; and

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- e) determining at least one surface property of the solid(s) or mixture(s) of solids from the measured power requirements as a function of time.

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